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MORTALITY DURING THE PERIOD 1938-42
FOLLOWING CUTTING BY TWO VARIATIONS OF THE
SELECTION SYSTEM IN PONDEROSA PINE
ON THE MALHEUR NATIONAL FOREST

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A study of the growth and mortality of the reserve stand in the ponderosa pine region following cutting by two variations of the selection system was begun in 1938 near Seneca, Oregon on the Malheur National Forest. It is not planned to measure growth until 1948. Observations in the mortality phase of the study for the period beginning in 1938 and extending to the last field inspection which was made in October 1942 will be summarized and compared with the mortality recorded in 1939 and 1940.

A large contiguous area was logged between 1936¹ and 1938 in which, by a "value" marking system, only those trees were cut² that would net the operator \$2.50 per M, b.m., as predicted by a previous study. A modifying provision states that 10 percent of the volume that would be marked by this rule might be reserved from cutting in order to save thrifty trees such as "3A" and "3B" and an equal volume in trees of marginal value lower than \$2.50 but not lower than \$1.00 might be substituted. It was the usual practice to substitute classes 4C and 4D trees for 3A and 3B trees.

Another large adjoining and mostly contiguous area was logged beginning in 1936³ in which the following "thrift" marking rule was used: No trees under 22 inches d.b.h. to be out and none cut to give release; all class "4" trees over 22 inches to be out unless needed for seed or to fill openings; no class "3A" to be cut; no class "3B" trees to be out unless of high mortality risk due to fork, lean, or fire scar; any class "3C" over 22 inches d.b.h. and of undesirable thrift or risk was to be out.

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- 1/ Kolbe, Ernest L. Working plan for a growth and yield study on the maturity selection cuttings on the Malheur National Forest. May 26, 1938. Office report.
 - 2/ McKay, Donald F. Initial report on the establishment of growth and mortality plots on the maturity selection cuttings on the Malheur National Forest. January 31, 1940. Office report.
 - 3/ Whiteside, J. M. & Norman, S. O. Relation of cutting practice to bark beetle losses in ponderosa pine stands of the silvics working circle, Malheur National Forest, Oregon, 1937-1939. August 12, 1941. Office report.

In the spring and fall of 1938 strip plots were established in the two cutting areas. Dead trees were blazed to avoid confusion with those dying during the course of later observations. In the spring of 1939 and 1940 and the fall of 1942 the strips were reexamined and any trees that died since the previous examination were then blazed and the tree class, cause of death, and size were recorded. The strip plots were 4 chains wide and 1 mile apart. A total of 1,785 chains of strip was established in the area cut by the value marking rule and 2,215 chains in the area cut by the "thrift" marking rule. At 10-chain intervals 0.4-acre plots 2 chains square were also established within the strips to obtain estimates of the reserve stand volume and growth and to obtain by means of stump measurements estimates of the original stand volume.

Each 0.4-acre plot was classified as to timber type and the stand data for north slope types were compiled separately for comparison with south slope types. (The north slope types were defined to include forest resource survey types 27 and 27.5; the south slope types included 20, 20.5, and 22. About 7 percent of the plots were other timber types such as 2, 5 $\frac{1}{2}$, 26, 31, etc.) The number of south slope plots was about 4 to 5 times as great as the north slope in both marking rule areas. The original stand in both marking rule areas contained about 16 M feet, B.M., per acre of all species in the south slope types and about 13 M feet, B.M., in the north slope types. Nothing is known of the proportions of different Keen tree classes among the ponderosa pine trees in the original stand. The ponderosa pine percentage of the total volume per acre, before and after cutting, for the areas falling in the two slope classes and marking rules was as follows:

	<u>Value marking rule</u>	<u>Thrift marking rule</u>
Original stand		
South slope types	59	86
North " "	51	31
Reserve stand		
South slope types	86	81
North " "	41	20

Nothing but ponderosa pines was cut. About 30 percent of the original pine volume was removed in the south slope types and about 38 percent in the north slope types under both marking rules. This pine removal amounted to about 27 percent of the volume of all species in the south slope types and 15 percent in the north slope types.

Growth measurements by the Bureau of Entomology and Plant Quarantine^{4/} in several parts of both the value and thrift marking areas indicate that the growing conditions before and after cutting were better on the thrift marking area.

^{4/} See footnote 3.

The mortality recorded represents two unequal periods of time because nearly all of the strips in timber cut by the value rule were established in the spring of 1938 but 60 percent of the area of strips in timber cut by the thrift rule were established in the fall of that year. Trees dead at the time of establishment were omitted from the records of mortality. Trees dying during the summer of 1938 on the strips established in the spring will appear in the mortality records, but those dying at the same time on the strips established in the fall will not appear in the records.

About one-half of the area marked by the thrift rule was logged during the summer just before the fall strips were established while parts of the area marked by the value rule were logged for various lengths of time up to 12 years before establishment. Reserve stand mortality from wind and insects is often greatest in the first few years after cutting. The observations on parts of these strips have thus missed the early mortality but on other parts have included all of it. The beetle losses after cutting, which were not recorded on the value marking area, consist in general of the trees dying in the summer and fall of 1937. On the thrift marking area they consist of similar 1937 losses on about one-half of that area and 1938 summer losses on about one-fourth of the area.

Since the only species cut was ponderosa pine, the major interest of the study is in the growth and mortality of that species following logging. Douglas-fir, white fir, and larch predominate on the north slopes and in the moist bottoms. Mortality was recorded for these species and for lodgepole but warrants little or no discussion here because these species tend to occur by themselves where the cutting of pine affected them very little.

The structure of the reserve stand of pine after cutting by each marking rule is shown in table 1. Conspicuous differences in the two marking rules are the greater proportion of class 4 and smaller proportion of class 3 trees in the reserve stand of the value marking rule. The class 3A trees occur in smaller proportion and the 3B's in greater proportion in the value marking area than in the thrift marking area. This is also true for the 4's but it is not apparent until the A and B classes are expressed as a percentage of the total of 4's only instead of as a percentage of all tree classes.

The loss in pine volume from 1938 to the fall of 1942 caused by insects, principally the western pine beetle, Dendroctonus brevicornis, is shown in table 2 in terms of percentage of the reserve stand volume for each tree class such as 3A, 3B, etc., at the time the strips were established. These percentages should not be confused with a percentage of the total pine volume. The percentages 2.1 and 1.4 for all tree classes combined do, however, express the total pine volume loss in terms of the total reserve stand volume. These two figures show a considerably greater tendency toward insect loss under the value marking rule than under the thrift marking rule. The difference of 0.7 is not a large figure but 2.1 is half again as great as 1.4. The losses in terms of board feet per acre were 183 for the value marking rule and 125 for the thrift marking rule.

The 4D and 4C trees left after cutting by the value marking rule suffered higher losses in proportion to their original volume than did any other tree classes under either marking rule. The 4D and 4B trees under the

Table 1.--Reserve Stand Structure of the Ponderosa Pine.
Percentage of Total Reserve Stand of Ponderosa
Pine 12" D.B.H. or More Occurring in Each Tree
Class Under Each Marking Rule

Tree class	Volume M.E.M.		Number	
	Value rule	Thrift rule	Value rule	Thrift rule
1 A	.1	.2	.8	1.7
B	.1	.1	.3	1.4
C	.0	.0	.2	.3
D	.0	.0	.1	.0
All 1's	.2	.3	1.4	3.4
2 A	1.6	1.5	3.2	3.0
B	2.6	2.0	6.8	6.1
C	1.6	1.0	6.3	5.0
D	.2	.1	.8	.7
All 2's	5.9	4.6	17.1	14.8
3 A	16.8	28.3	7.8	13.7
B	36.6	34.8	26.7	25.1
C	15.9	15.1	25.7	23.5
D	2.8	3.1	7.9	11.7
All 3's	72.0	81.4	68.1	73.9
4 A	4.8	3.8	1.5	1.2
B	11.3	5.5	5.1	2.5
C	5.0	3.8	5.3	2.8
D	.7	.6	1.5	1.5
All 4's	21.8	13.7	13.4	8.0
Total percent	100	100	100	100
Basis per acre	8,670'	8,747'	14.6 trees	12.0 trees

**Table 2.--Percentage of the Reserve Stand Volume in
Each Tree Class Killed by Insects, Prim-
cipally the Western Pine Beetle, During
the First 4 Years Following Establishment
of the Plots in 1938**

Tree class	Value marking rule	Thrift marking rule
2 A	0.4	0.1
B	0	0.4
C	0	0.1
D	0	0
All 2's	0.1	0.3
3 A	1.1	0.6
B	1.5	1.2
C	2.5	1.8
D	2.6	1.6
All 3's	1.7	1.1
4 A	0	2.1
B	3.1	4.1
C	7.8	2.8
D	11.2	6.6
All 4's	3.7	3.3
All classes	2.1	1.4

thrift marking rule gave greater proportions of loss than did other tree classes under the same rule. The greater proportion of loss in 4B's than 4C's under this rule was a reversal of the relationship to be expected.

The ponderosa pine losses from insects have decreased greatly in the last 2 years of the period 1938-42. The following figures are the board-foot losses per acre found in each marking rule area at each examination following establishment in 1938:

	<u>Value marking rule</u>	<u>Thrift marking rule</u>
Spring 1939 examination	70	32
" 1940 "	77	67
Fall 1942 "	<u>36</u>	<u>26</u>
Total	183	125

The figure for 1939 under the thrift rule is not comparable with the others because, as mentioned before, the losses on most of this area date from the previous fall instead of the previous spring. The losses recorded in 1942 are for a 2-1/3-year period and when divided by 2-1/3 for direct comparison with the loss recorded in 1940 it is found they are only 1/5 to 1/6 as great.

The total ponderosa pine losses from insects, windfall, fungi, etc., since the study strips were established amounts to 200 board feet per acre or 2.3 percent of the reserve stand for the value marking rule and 148 board feet per acre or 1.6 percent of the reserve stand for the thrift marking rule. Details of these losses are shown in appendix tables A and B. The losses per year derived from these figures are equal to about 50 percent of the annual growth in virgin stands on similar sites.

APPENDIX TABLE A

Percentage of Reserve Stand in Each Tree Class and Marking Rule Lost to Insects
and Other Causes from Time of Establishment in 1938 to October 1942

Tree class	Value marking rule						Tree thrift marking rule					
	Insect losses		Other losses		All causes		Insect losses		Other losses		All causes	
	Number	Volume	Number	Volume	Number	Volume	Number	Volume	Number	Volume	Number	Volume
2 A	.3	.4	.3	0	.6	.4	.6	.1	0	0	.6	.1
B	.1	0	0	0	.1	0	1.0	.4	.3	0	1.3	.5
C	.2	0	0	0	.2	0	.3	.1	0	0	.3	.1
D	0	0	0	0	0	0	0	0	0	0	0	0
All 2's	.2	.1	0	0	.2	.1	.6	.3	.1	0	.8	.3
3 A	1.6	1.1	.2	.1	1.8	1.3	.7	.6	0	0	.7	.6
B	1.6	1.5	.2	.1	1.8	1.7	1.2	1.2	.2	.2	1.5	1.5
C	2.7	2.5	.2	.2	2.9	2.7	2.1	1.8	.1	.3	2.2	2.1
D	3.7	2.6	.2	.3	3.9	2.9	2.2	1.6	0	0	2.2	1.7
All 3's	2.2	1.7	.2	.2	2.4	1.9	1.5	1.1	.1	.1	1.7	1.3
4 A	0	0	0	0	0	0	3.9	2.1	0	0	3.9	2.1
B	4.4	3.1	.4	.2	4.9	3.3	4.7	4.1	1.0	1.9	5.7	6.0
C	7.5	7.8	.4	.3	7.9	8.2	5.7	2.8	0	0	5.7	2.8
D	16.9	11.2	1.9	5.5	18.8	16.7	4.3	6.6	0	0	4.3	6.6
All 4's	6.5	3.7	.5	.3	7.0	4.1	4.8	3.3	.3	.7	5.2	4.0
Total pine	2.4	2.1	.2	.2	2.6	2.3	1.6	1.4	.1	.2	1.8	1.6
Total other species	1.2	2.1	.4	.9	1.6	3.0	1.3	1.6	.4	.4	1.8	2.0
Total all species	2.1	2.1	.3	.3	2.4	2.4	1.5	1.4	.2	.3	1.8	1.7

APPENDIX TABLE B

Mortality Per Acre in Terms of Number of Trees and Volume in Each Tree Class
and Marking Rule Lost to Insects and Other Causes from Time of Establishment in 1938 to October 1942

Tree class	Value marking rule						Tree thrift marking rule					
	Insect losses		Other losses		All causes		Insect losses		Other losses		All causes	
	Number	Volume	Number	Volume	Number	Volume	Number	Volume	Number	Volume	Number	Volume
2 A	.0014	.51	.0014	.04	.0028	.55	.0022	.22	0	0	.0022	.22
B	.0014	.07	0	0	.0014	.07	.0078	.81	.0022	.13	.0100	.94
C	.0014	.07	0	0	.0014	.07	.0022	.17	0	0	.0022	.17
D	0	0	0	0	0	0	0	0	0	0	0	0
All 2's	.0042	.65	.0014	.04	.0056	.69	.0122	1.20	.0022	.13	.0144	1.33
3 A	.0171	17.66	.0028	1.99	.0199	19.65	.0122	16.77	0	0	.0122	16.77
B	.0627	50.01	.0086	3.95	.0713	53.96	.0367	38.29	.0088	8.79	.0455	47.08
C	.0997	35.59	.0085	3.38	.1083	38.97	.0590	24.20	.0045	4.73	.0635	28.93
D	.0427	6.18	.0028	.77	.0455	7.25	.0311	4.60	.0011	.25	.0322	4.85
All 3's	.2222	109.74	.0227	10.09	.2450	119.83	.1391	83.86	.0144	13.77	.1534	97.63
4 A	0	0	0	0	0	0	.0055	7.08	0	0	.0055	7.08
B	.0327	31.31	.0028	2.37	.0355	33.68	.0144	19.91	.0033	9.17	.0177	29.08
C	.0583	34.91	.0028	1.58	.0611	36.49	.0189	9.72	0	0	.0189	9.72
D	.0370	6.51	.0012	3.22	.0412	9.73	.0077	3.31	0	0	.0077	3.31
All 4's	.1280	72.73	.0098	7.17	.1378	79.90	.0465	40.03	.0033	9.17	.0498	49.19
Total pine	.3545	183.12	.0339	17.30	.3885	200.42	.1978	125.09	.0199	23.07	.2177	148.16
Total other species	.0640	55.73	.0213	23.39	.0853	79.12	.0844	55.08	.0312	13.93	.1155	69.01
Total all species	.4185	238.85	.0552	40.69	.4738	279.54	.2821	180.16	.0511	37.01	.3333	217.18